CHAPTER 25

COFFERDAMS AND SHEET PILING

25.1 Cofferdams

- When identified by the Designer as a project requirement, the use of Cofferdams shall be scheduled in a project. Cofferdams shall be constructed to protect a foundation and its construction against damage from a rise in water elevation.
- The Designer shall clearly identify at the Preliminary submission when the use of a steel sheet piling cofferdam system, that is to remain in place, is required. Necessary dewatering, and the bracing that is needed to withstand external forces that are to be sustained during construction of a project's substructure unit(s), should be evaluated to make this determination.
- When this has been identified, a complete design of the steel sheet piling cofferdam system shall be provided. This design shall be included in the contract plans. The minimum required tip elevation of the sheeting shall be detailed.
- When a steel sheet piling cofferdam system is not required, the use of sheeting, dikes, well points or other means will be permitted for dewatering the foundation area. Such cofferdam systems, with all false work, sheeting and bracing, shall be removed after the completion of the substructure unit's construction.
- When the flow of water cannot be controlled, a cofferdam system that utilizes a concrete seal shall be provided. The concrete seal shall be placed below the water and below the bottom elevation of the footing. Sheet piling below the top of seal concrete, shall be designated to be left in place.

25.2 Temporary Sheeting

- The use of Temporary Sheeting shall be based on conditions where protection of property (embankment control), traffic (stage construction), utilities, construction safety code requirements, etc. is a construction consideration.
- Ordinarily the design and type of temporary sheeting is the choice of the Contractor. However, it shall be the responsibility of the Designer to review borings and subsurface soil reports so that any adverse subsurface conditions can be identified. In such cases, the Project's Special Provisions shall provide guidance as to type of sheeting that can be used and any driving and pulling directions that must be followed.

25.3 Sheeting Left in Place

When it is identified by the Designer that steel sheet piling is warranted and is the only means to facilitate any phase of a project's construction, the use of Sheeting Left In Place shall be scheduled in the Contract Documents.

25.4 Construction Requirements

- Material for steel sheet piling shall conform to **AASHTO M202 or AASHTO M270, Grade 50.**
- Sheet piling that is to be used in a marine environment shall also conform to **AASHTO M270, Grade 50**. For such instances, it shall be coated with a 406-micrometer application of coal tar epoxy as per **SSPC Paint Specification No. 16.**

25.5 Subsurface Explorations

- Required borings shall be located on the plan of the structure by station and offset from the base line. Five copies of the print shall be enclosed with the memorandum of transmittal. Request for borings shall be made as early as possible in the preliminary design stage.
- At least two borings shall be made for each bridge substructure unit. For long retaining walls and culverts, borings should be spaced not greater than 100 ft. apart. One boring shall be provided at each footing location for both overhead and cantilever sign structures and high-level light tower foundations.
- Where piles are anticipated, depths of borings shall be determined accordingly. The borings shall be deeper than any anticipated pile lengths.
- Location of borings and identification numbers shall be shown both on preliminary and final General Plan and Elevation sheets for each bridge and structure.
- Subsurface soil profiles and boring log information shall not be shown on the contract plans. Copies of boring logs are available to bidders as separate documents.
-

25.6 Pile Foundations

To provide a general idea for the proper use of the following methods, the following guidelines for jetting and pre-boring are given:

- Jetting
  - Not to be used where a disturbance to existing foundations or utilities would result.
  - Not to be used where disposal of jet water and soil would be a problem.
  - In general, jetting would be used in very dense granular or silty soils where displacement piles are being driven in water.

- Pre-Boring
  - To be used when displacement piles are to be driven through a compacted-fill over 10 ft. high.
  - To be used where driving piles full depth would disturb adjacent structures or utilities. Additionally, a survey, with photographs, should be performed before and after pre-boring and pile driving operations to verify occurrence of any damage to structures or utilities.
  - Should not be used below bearing soils for friction piles.
  - In loose granular soils or soft cohesive soils drilling mud may be necessary to keep the hole open.

25.7 Scour at Bridges

25.7.1 Scour, General or Contraction

In a channel, general/contraction scour usually affects all or most of the channel width and is typically caused by contraction of the flow.

25.7.1.1 Scour, Local

Scour in a channel or in a flood plain that is localized at a pier, abutment or other obstruction to the flow.

25.7.1.2 Thalweg

A line extending down the length of a channel that follows the lowest elevation of the bed. Refer to **FHWA Hydraulic Engineering Circular (HEC) No. 20 entitled Stream Stability at Highway Structures,** for additional definitions regarding stream geomorphology and scour.

25.7.2 General

- All bridges located over a waterway, shall be designed to resist scour, through methods outlined in **FHWA HEC No. 18 entitled Evaluating Scour at Bridges, and FHWA HEC No. 20 entitled Stream Stability at Highway Structures.**
- All bridge foundations shall be designed to withstand the effects of scour from a 100-year flood criterion, that is expected to produce the most severe condition. A factor of safety of 2 to 3 shall be used to account for the effects of this flood. The foundation design shall be checked for a 500-year superflood, or 1.7 times a 100-year flood, if 500-year superflood information is not available from published sources, and modifications made where required. All foundations should have a minimum factor of safety of 1.0 under the superflood conditions. When evaluating existing bridges, the superflood criteria shall be the 100-year discharge, that is expected to produce the most

severe condition. However, in some cases a flood discharge greater than the 100-year flood criteria may be necessary. These cases will be evaluated on a bridge-by-bridge basis.
- If required, the Preliminary submission shall include a Hydraulic and Scour Report that should establish a design procedure for scour resistance. The following structural elemental information should be addressed in this Report.

25.7.3 Superstructure

- When practical, the elevation of the bridge superstructure should be above the general elevation of the approach roadways.
- For streams that carry a large amount of debris, the elevation of the lower cord of the bridge should be increased a minimum of 2 ft. above the normal freeboard for a 100-year flood.

25.7.4 Abutments

- Rock riprap, guide banks (spur dikes) and other scour countermeasures as outlined in **Chapter 7 of HEC No. 18** shall be considered for use on a project-by-project basis on bridge rehabilitation projects as determined by a bridge scour evaluation.
- The design of abutments should consider that the channel may shift and scour may occur at the abutment.

25.7.5 Piers

- The number of piers in any stream channel should be limited to a practical minimum, and piers should not be located in the channel of small streams, if it is possible to avoid such locations.
- Piers shall be aligned with flow direction at flood stage in order to reduce drift build up, reduce the contraction effect of piers in the waterway, minimize ice forces and the possibility of ice dams forming at the bridge and to minimize backwater and local scour. The top of footing shall be a minimum of 3 ft. below the waterway bed.
- Piers subject to tidal conditions shall be protected on all sides by granite masonry facing or a stainless steel protection plate. The limits shall extend 2 ft. to 3 ft. above the mean high water line to 2 to 3 ft. below the mean low water line.
- If there is a possibility that the channel will shift its location in the flood plain during the expected 75 – 100 year life of the bridge, pier foundations in flood plains should be designed to the same elevation as the pier foundations in the stream channel.

NOTE: Evaluate the hazard of ice and debris buildup, particular for multiple pile bents. Evaluate a bent pier as though it is a solid pier for scour estimation. Consider the use of other pier types.

25.7.6 Foundations

- The bridge foundation analysis shall be performed on the basis that all stream bed material in the 100 year scour prism above the total scour line has been removed and is not available for bearing or lateral support.
- When designing pile foundations, the piles shall be designed for reduced lateral restraint and column action requirements due to the increase in unsupported pile length after scour occurs. Additional lateral loads due to stream pressure should be included in the pile design. Consideration should be given to using a lesser number of longer piles as compared with a greater number of shorter piles to develop bearing loads. This approach will provide a greater factor of safety against pile failure due to scour at little or no increase in cost.
- For spread footings on soil, ensure that the top of the footing is at or below long-term degradation, contraction scour and lateral migration considerations. Place the bottom of the footing below the total scour line.
- For spread footings on highly resistant rock, place the bottom of the footing on a cleaned rock surface (consider doweling for lateral restraint).
- For spread footings on erodible rock, consult an Engineering geologist for the rock quality and local geology. Estimate the potential scour depth and place the footing base below that depth. Place the final footing in contact with the sides of excavation and fill the excavation above the footing with riprap.
- For spread footings on tremie seals and soil, place the bottom of the footing below the total scour line and ensure that the top of footing is at or below the sum of long-term degradation and contraction scour. This will minimize obstruction during flood flow and minimize any local scour.
- For deep foundations (drilled shafts or driven piles) with footings or caps, place the top of the footing below the stream bed a depth that is equal to the estimated long term degradation and contraction scour to minimize obstruction during flood flow and minimize any local scour.
- Local scour holes at piers and abutments should not overlap (top width of a scour hole can be as much as 2.8 times the depth of scour).